agricultural research

U S. DEPARTMENT OF AGRICULTURE SEPTEMBER 1978

agricultural research

September 1978/Vol. 27, No. 3

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COVER: Researchers at SEA's U.S. Water Conservation Laboratory in Phoenix are developing water harvesting techniques to increase the seed yield and wax production of jojoba, a valuable desert plant in the southwestern U.S. and northwestern Mexico. Story begins on page 8 (0478X397–21A).

AGRICULTURAL RESEARCH is published monthly by the Science and Education Administration (SEA), U.S. Department of Agriculture, Washington, D.C. 20250. The Secretary of Agriculture has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 15, 1982. Yearly subscription rate is $6.50 in the United States and countries of the Postal Union, $8.15 elsewhere. Single copies are 55 cents domestic, 70 cents foreign. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

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U.S. Department of Agriculture

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Science and Education

The Promise of Jojoba

LIKE the fascinating guayule plant that was the subject of this column last month, the jojoba is native to the same hot, dry, desert wastelands of the American Southwest. And like the guayule, the jojoba may soon bring life to its desert home and livelihood to the people who live there.

Jojoba is native to the Sonoran desert of Mexico, Arizona and California. The desert shrub produces seeds about the size of peanuts and which contain a liquid wax, frequently called jojoba oil. That oil is similar to sperm whale oil in its suitability as a high pressure lubricant and in its resistance to oxidation. But sperm whale oil is not generally available. The sperm whale was placed on the endangered species list in 1971, a move that banned all whale products from entering the U.S.

The uses of jojoba oil appear to be extremely diversified. It has proven successful as a lubricant for high speed equipment. The oil may be used as an ingredient in carbon paper, stencils, pharmaceuticals and cosmetics. It has potential for use in printing inks, paper coatings, polishes, electrical insulation and in the manufacture of linolium. The meal that remains after the oil is pressed from the jojoba seed contains 30 to 35 percent protein and may have potential as a livestock feed.

A mature jojoba plant may be older than the knowledge of its oil. The plants are thought to live longer than a century, and some living jojobas may actually have been alive in 1789, when the first known article on jojoba was published. That article ascribed remarkable medicinal properties to the seeds and their oil.

Water harvesting is a technique for accumulating scarce water from rain or snow runoff and channeling that water to the plants. SEA scientists have recently been experimenting with water harvesting specifically as a means to increase jojoba seed production and to shorten the amount of time it takes to grow the plants to maturity.

A new jojoba industry would mean a new, renewable resource that has not existed before. But the promise of jojoba is more than that. A jojoba-based industry could help to bring economic vitality to the Sonoran desert and to the people who live there. And that may be the biggest promise of all.—*R.W.D.*

Orphaned lambs readily take to professor Frederiksen's semiautomated pipeline feeding system designed for large scale artificial lamb rearing. When milk in the pipe reservoir breaks contact with low level electrodes, more milk flows in from a refrigerated tank (0678X622–9).

It Feeds Orphaned Lambs

A SIMPLE, relatively inexpensive semi-automated milk-feeding system that can be used to profitably rear orphan lambs has been designed at SEA's U.S. Sheep Experiment Station in Dubois, Idaho.

Last year more than 3.6 million pounds of lamb meat were lost to the market because the lambs died of starvation during their first week after birth. The lambs starved because, for one reason or another, their mothers were unable to raise them.

Artificial rearing of orphan lambs dates back to biblical days when the skins of dead lambs were sewn onto

orphan lambs so that the dead lamb's mother would raise the orphan as her own. More recently, sheep producers have hand-fed lambs with milk replacer formulas, but this involves too much labor and isn't too keen for the lambs either. Hand-fed lambs eat when it is convenient for the feeders—not when they're hungry!

In cooperation with SEA, Kenneth R. Frederiksen, University of Idaho research professor, has devised a system that allows lambs to feed themselves whenever they choose to do so. Constructed from parts and equipment readily available from commercial sources (sheep producers can construct the system themselves), Frederiksen's milk-feeder keeps milk replacer clean and cold, prevents milk wasteage and is easy to maintain.

The new milk-feeder is successful with 90 to 95 percent of the orphan lambs being reared on it and can be used anywhere that lambs are produced. Completely automated milk-feeding systems are not yet commercially available. Frederiksen's milk-feeder may offer an interim solution to the orphan lamb problem.

Professor Frederiksen's address is U.S. Sheep Experiment Station, Dubois, ID 83423.—*L.C.Y.*

Above right: *Research aide Charlotte Rich liquifies powdered milk containing nutrients specially prepared for nursing lambs (0678X626–8).*

Right: *Professor Frederiksen keeps nurser milk cool with a jug of frozen water. This "nonautomated" nurser is designed for small operations involving up to 50 orphaned lambs (0678X623–29A).*

Several Weeds Found Good for Sheep

WHEN a farmer finds certain common weeds scattered about his newly-established alfalfa field, he may not be as bad off as he thinks.

A dozen common weeds were subjected to nutrition evaluation in the laboratory and to taste tests by a panel of sheep. Eight "weeds" came through with high ratings.

Some of the weeds found in hay fields are just as good as alfalfa if they are harvested at early stages of maturity, according to plant scientist Dr. Gordon C. Marten and plant physiologist Dr. Robert N. Anderson, St. Paul, Minn.

Of the 12 common weeds taste-tested, sheep apparently enjoyed six: redroot pigweed, Pennsylvania smartweed, common lambsquarters, barnyardgrass, and both yellow and green foxtail. Some sheep also liked common ragweed and velvetleaf, but others did not.

Four weeds unpalatable to sheep were: common cocklebur, giant ragweed, wild mustard, and giant foxtail.

However, it turned out that sheep are not better than people at eating what is good for them. Dr. Marten said the analyses of nutritive values showed sheep ate what they liked with no regard for what was best for them. They could not go far wrong, however, because 9 of the 12 weeds tested contained more crude protein than does oat hay and 10 weeds were more digestible than oat forage.

The objective of the study, Dr. Marten said, was to find out whether some common annual broadleaf and grass weeds, normally considered problems in new plantings of forage crops such as alfalfa, are high enough in nutritive value and palatability to be left to grow as part of the hay crop.

"On the basis of the research results we think farmers can sometimes seed perennial forage crops such as alfalfa and clover without applying herbicides to kill the weeds," Dr. Marten said.

"Of course, if the weeds are so thick they will crowd out the new stand of perennial forage, then control measures should be used. But, if the weeds are not too thick and are of the palatable species, herbicides need not be used."

Laboratory tests for nutritive value during each of 3 years of the project included measurement of digestible dry matter and crude protein. The weeds were also evaluated for content of copper, potassium, phosphorus, magnesium, aluminum, iron, zinc, calcium, boron, and manganese. All the weeds tested contained adequate minerals to meet the requirements of ruminants.

Digestible dry matter levels of pigweed, lambsquarters, common ragweed, yellow foxtail, and barnyardgrass were about the same as alfalfa. The leaders in crude protein content were velvetleaf, lambsquarters, and pigweed. Giant foxtail was lowest in crude protein content.

"Redroot pigweed, common lambsquarters, and common ragweed had nutrient composition and digestibility essentially equivalent to that of high quality alfalfa, especially when they were fertilized with nitrogen," Dr. Marten said.

Scientists warn that at times, such as during severe drought conditions, some weeds can accumulate toxic amounts of nitrates; however, nitrates were not a problem in this study.

Dr. Gordon Marten and Dr. Robert Andersen are at the Agronomy Building, Room 404, University of Minnesota, St. Paul, Minn. 55108—*R.G.P.*

Grass Tetany: Some Helpful Research

In experiments aimed at controlling the growing problem of grass tetany in the U.S., scientists of the U.S. Pasture Research Laboratory in University Park, Pa., discovered that different cultivars of forage grass and legume species have widely different abilities to take up magnesium from the soil.

Grass tetany, also known as "staggers" or hypomagnesemia, is a serious metabolic disorder afflicting grazing animals and is caused primarily by insufficient magnesium in their diet. USDA and state surveys indicate that grass tetany occurs in almost all the Nation's states, involving 1 to 2 percent of the grazing livestock at an annual cost of $70 million.

SEA soil scientist Mr. C. F. Gross and SEA agronomist Dr. G. A. Jung ran greenhouse trials on 22 temperate-origin grasses and legumes for 15 months. They designed the trials to determine how magnesium concentrations in the herbage are affected by (1) different seasons and (2) applications of magnesium fertilizer. About every 3 weeks, the scientists took samples by cutting test plants to 5 centimeters in height. Then, they identified "magnesium-accumulator" species and cultivars by analyzing the samples for mineral composition.

Their test results demonstrate that it may be feasible to prevent grass tetany, not only through selection of forage plant *species* which can take up sufficient amounts of magnesium for livestock, but also through selection and breeding of cultivars *within* certain species which are presently known as low-magnesium forage plants.

For example, the SEA scientists found that Timfor timothy, a new cultivar, contained 65 percent more magnesium than commonly grown Climax timothy, when grown under simulated cool spring conditions. Results on Timfor from this and other trials go against the common notion of timothy as a low accumulator of magnesium in spite of being a nutritious and highly palatable livestock forage plant. Also, Timfor, unlike Climax, had well above the critical magnesium levels often used to indicate the potential of a forage plant to induce grass tetany.

Among the legume cultivars grown by Mr. Gross and Dr. Jung under cool spring conditions, Saranac alfalfa contained 48 percent more magnesium than Vernal alfalfa. For all plants grown under a simulated cool spring, the high accumulators of magnesium were Timfor timothy, Nordstern orchardgrass, Viking birdsfoot trefoil and Saranac alfalfa. Timfor and Viking had approximately twice the magnesium concentration of some low accumulating grasses and legumes.

Grass tetany is also related to potassium levels in livestock diets. When potassium levels are excessively high, the element interferes with the ability of livestock to utilize dietary magnesium in their bodies. The pasture lab experiments showed that most grasses and legumes took up more magnesium and less potassium in a simulated cool autumn environment than in a simulated cool spring setting. The scientists suggest that this may help explain why grazing animals are more subject to grass tetany in the spring than in the fall.

Having established that high magnesium cultivars can be identified, the scientists applied magnesium fertilizer to the test plants, another option in preventing grass tetany. Among the grasses fertilized (with 672 kilograms of magnesium per hectare), Timfor timothy, Nordstern orchardgrass, and Ioreed reed canarygrass responded most favorably under cool conditions.

Timfor timothy took up five times more magnesium fertilizer than did Climax timothy, and Nordstern took up twice as much as did Pennlate and Potomac orchardgrass.

Also under cool spring conditions, the legume plants which best increased their magnesium levels after fertilization were Viking birdsfoot trefoil, ladino clover, and Aurora alsike clover. Birdsfoot trefoil took up from two to seven times more fertilizer magnesium than did other legumes. As temperatures increased from early May to late June, only Regal white clover, Iroquois alfalfa, Ioreed canarygrass, and Combi perennial ryegrass showed increases in their herbage magnesium.

To help prevent grass tetany from occurring in early spring, Mr. Gross and Dr. Jung suggest that farmers consider using a legume that is a high accumulator of magnesium, or is responsive to magnesium fertilization, in a seed mixture with a forage grass that is a good accumulator of the element—Timfor timothy, for example.

From these experiments and those conducted elsewhere, the scientists indicate that there are at least four practical options for preventing magnesium deficiencies in ruminant animals: (1) selecting species and cultivars of forage plants which have the inherent ability to accumulate magnesium or those which respond best to magnesium fertilizer; (2) fertilizing pastures with magnesium; (3) avoiding use of heavy nitrogen and potassium fertilizer applications; and (4) supplementing the ration or water with magnesium.

Currently, the scientists are cooperating with Dr. R. L. Reid of West Virginia University to determine the extent to which plant species and cultivars, plant growth stage and magnesium fertilizer affect the ability of grazing animals to absorb and to retain magnesium in their body tissues.

Mr. Charles Gross and Dr. Gerald Jung are at the U.S. Regional Pasture Research Laboratory, University Park, Pa. 16802.—*S.M.B.*

Can Mosquitoes Resist Biocontrol?

RESISTANCE by pests to chemical control has been widely documented, but resistance can occur in biological control as well. A laboratory-reared strain of the southern house mosquito, *Culex quinquefasciatus* Say, for example, has developed resistance to the mermithid nematode, *Romanomermis culicivorax* Ross and Smith, after 300 generations. The mermithid nematode parasitizes a wide range of mosquito species. It has been studied for 10 years as a biological control agent.

Observations of the laboratory colony of southern house mosquitoes revealed that after 115 generations it became necessary to increase the parasites from 12 to 15 per host to maintain the high levels of parasitism needed for mass rearing. It was necessary to determine the level of resistance of the laboratory colony.

Each test consisted of 4 replicates of 100 larvae of each strain placed in separate 100 milliliters (ml) beakers containing 50 ml of water. Each beaker of larvae was exposed to the desired number of parasites for 24 hours and then transferred to rearing pans. After 7 days the incidence of parasitism was determined. The ratios of parasites to hosts tested were 2.5 to 1, 5 to 1, and 7.5 to 1, respectively.

In three of five tests only mortality was measured. In two tests, 10 to 20 larvae were removed from each beaker 24 hours after exposure and dissected to determine the extent of parasitism. Just prior to nematode emergence, infected hosts were isolated in individual cells of spot plates, and the nematodes were allowed to emerge so the number of nematodes per host and the total number of nematodes produced could be determined.

The results revealed that parasitism was 32 to 42 percent higher in a native strain than in the laboratory strain. According to Dr. James J. Petersen, there is no doubt that resistance has developed in the laboratory strain as a result of the practice of using exposed but uninfected hosts to maintain the colony of adult mosquitoes. This resistance is not expected to occur in nature. Further studies are underway to help delineate the extent and nature of the resistance. The mechanism of resistance can be physical, behavioral, physiological or a combination of these.

Dr. James J. Petersen is with the Gulf Coast Mosquito Research Laboratory, 803 Avenue J and Chennault, Lake Charles, LA. 70601.—*E.L.*

Water Harve
Yield of Joj

WATER harvesting, a technique for gathering and storing runoff from rain or snow to quench the thirst of livestock and wildlife on near-desert rangelands, has been used successfully to dramatically increase the yield of seeds on native jojoba (ho-*ho*-ba) bushes in areas that average only 9 inches of rain per year.

SEA plant physiologist William L. Ehrler, soil scientist Dwayne H. Fink and technician Stanley T. Mitchell, all of Phoenix, Ariz., think that increasing yields of existing stands has several advantages over plantation expansion.

Among the advantages are that existing plants are already mature and producing (jojoba can live 100 years or more) and the several years lag-time associated with this slow-growing shrub is thus avoided: existing jojoba stands are on marginal land, whereas new plantations normally would compete for land already producing agricultural crops; and plantation stands would require irrigation, and thus compete for already scarce water supplies. Native stands generally make do with local rain.

Jojoba, a plant of the Sonoran Desert, produces peanut size seeds containing a high quality, heat-tolerant wax for which there would be a great industrial demand if a reliable supply could be assured. The plant occurs naturally on about 90,000 acres of the desert in Arizona, California, and Mexico.

Left: A neutron soil moisture probe enables Dr. Fink to measure moisture at depths down to the root bottoms (0478X398–28).

sting Boosts ba Seed

Jojoba wax is an excellent substitute for now rare sperm whale oil renowned for its tolerance to high temperatures and oxidizing conditions. The wax can be used in the cosmetic, pharmaceutical, and printing industries, as well as many others, and its production could relieve some of the pressure on the endangered sperm whale.

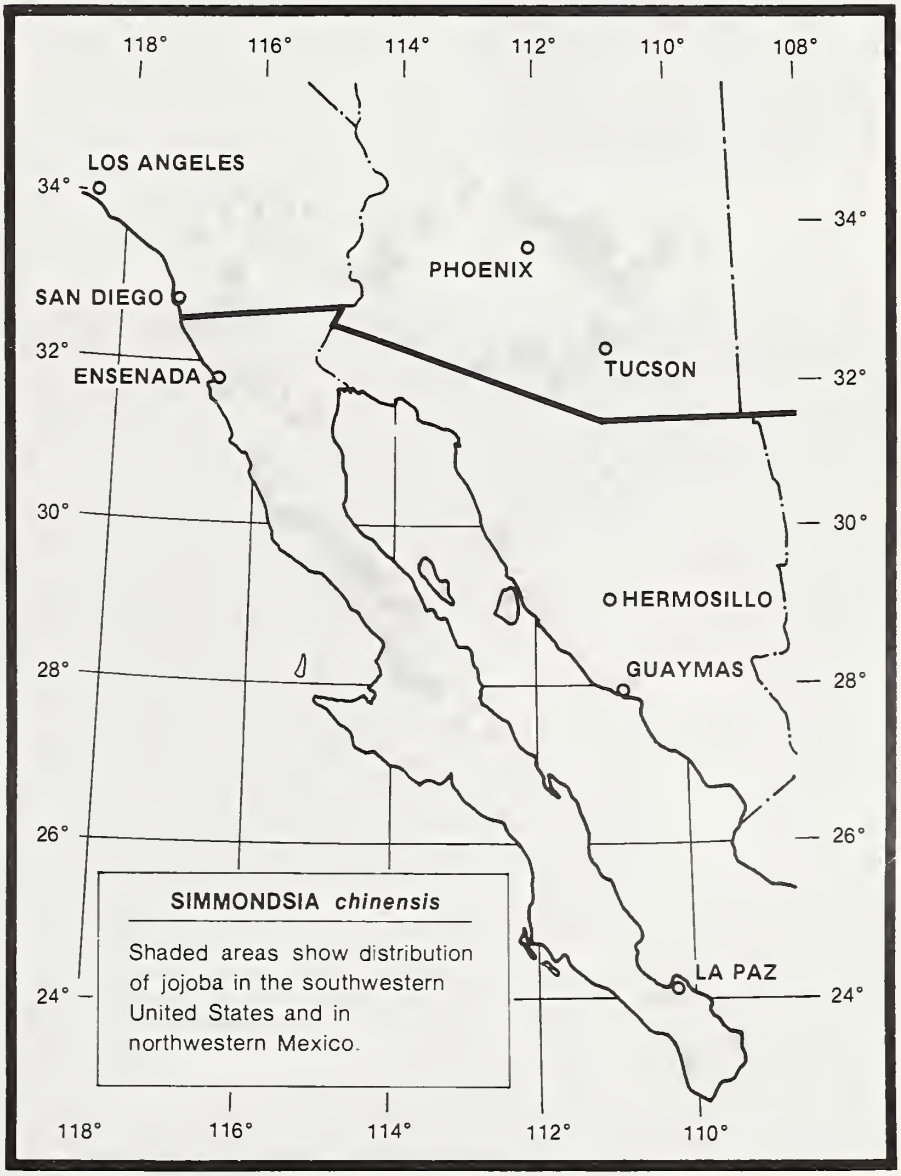
SEA scientists began a study 4 years ago to see if yields could be significantly increased with extra water and to find out the plant-water soil relationships of the "new" crop. After those 4 years, plants receiving harvested water are eight times as productive as undisturbed control plants.

The Federal researchers chose—in cooperation with the Forest Service—a 2½ acre site near Phoenix that contained marginal, native jojoba of small plant size in an area that had an average rainfall of 9 inches—far below the plant's normal water requirements.

Within the 2½ acre fenced site near Phoenix, 30 female plants were chosen. Ten of the plants were left undisturbed, while ten others had a 20-square-yard triangle-shaped area above them cleared, smoothed, rolled and surrounded by a berm or shoulder to direct precipitation to a 4-square-yard area around each plant. Ten other plants had areas treated similarly to the second set except those areas were treated with a water repellent—first low-grade oil, and later granulated paraffin wax.

The 4-year average of rainfall/runoff for the sites during the critical growth-yield period October through June was 6 inches for the control and 9 and 35 inches for the first and second treat-

Above: Dr. Fink applies cellulose-xanthate to soil as a stabilizer overlayered with various waxes. Cellulose-xanthate could provide a cheaper, more efficient, and more durable treatment for catchment basins without having to use nonrenewable resources such as those found in petrochemicals (0478X400–15). Shaded areas show distribution of jojoba in the southwestern United States and in northwestern Mexico (PN–4168).



Above: Dr. Ehrler uses a pressure "bomb" to measure plant water stress (0478X398–14).

ments. Plant volume increase for the three treatments was 43, 44, and 237 percent, respectively.

Seed yield the first year was small but the trend was obvious. Average yield per plant for the undisturbed treatment was only 0.02 ounce, while yields for the first and second treatments were 0.3 and 1 ounce, respectively.

Frost injury destroyed the flowers in 1975 and 1976, but in 1977 the yield of seeds showed about 1 ounce on the control and 2.8 ounces on the first treatment, and about 7 ounces on the catchments treated with the water repellant. Best yield was more than a pound (514 grams) on one bush.

Since few growers or marketing agents could withstand 2 frost-loss years in 4, Dr. Ehrler suggests choosing sites at lower elevations, provided they are not in a cold-air drainage pocket. However, such warmer, lower sites—at least in the West—generally have lower rainfalls. To overcome that development, he suggests larger collecting areas.

"We will continue to study to determine if yields will continue to increase to a profitable level—whatever that is," Dr. Ehrler said.

"The good yield and plant volume increase in the second treatment in 1976–77 with only 22 inches of water represents a sparing use of water for a perennial crop in a hot climate in an oasis-like environment.

"We are considering other inexpensive treatments to increase the runoff efficiency of the first treatment (no repellant), or simply increasing the catchment size," Dr. Fink says.

The researchers are stationed at SEA's U.S. Water Conservation Laboratory, 4331 E. Broadway Road, Phoenix, AZ 85040.—*J.P.D.*

***Below:** Jojoba seeds as they come from the bush (right) and shelled (left) (0275X116–5A).*

Lower Cholesterol from High Fiber Bread?

BREAD made high in fiber by adding hard red spring wheat bran, finely ground soybean hulls, or corn bran was associated with lowered cholesterol levels in blood serum of some volunteers who consumed the bread.

Healthy men who volunteered for the study lived in the metabolic unit of SEA's Human Nutrition Laboratory, Grand Forks, N. Dak., for periods of 4 to 8 months. Each volunter participated in several 30-day phases of the research, consuming a control diet or the control diet supplemented with one of several fiber sources.

"We designed the control diet to typify middle-class American diets," said SEA medical officer Juan M. Muñoz. The experimental diets differed from the control diet only in that each day's bread contained about 26 grams (nearly 1 ounce) of the fiber source.

Serum cholesterol levels of all of six men were lowered significantly as they consumed diets that contained soybean hulls or hard red spring wheat bran. The cholesterol levels in four of six volunteers were lowered as they consumed diets that contained corn bran. Soft white wheat bran or textured vegetable protein generally failed to lower serum cholesterol.

After the volunteers had consumed diets supplemented with finely ground soybean hulls for a month, Dr. Muñoz and his colleagues found that total cholesterol levels in the blood plasma averaged 156 milligrams per 100 milliliters. That was an average 14 percent decline from the cholesterol levels of the individuals when they were fed the control diet. The researchers observed similar declines in total cholesterol when diets containing hard red spring wheat bran were consumed. Levels of low density lipoprotein (LDL) cholesterol associated with those diets were about 30 percent lower than levels associated with control diets.

Dr. Muñoz found that consumption of corn bran, finely ground soybean hulls, apple powder, or carrot powder improved glucose tolerance or the ability of individuals to use carbohydrates efficiently. The study demonstrated, however, that not all sources of dietary fiber are equally effective in improving glucose tolerance, or in lowering serum cholesterol.

The researchers at Grand Forks found that lowered levels of LDL and total cholesterol were generally associated with improved glucose tolerance.

Dr. Juan M. Muñoz is at the Human Nutrition Research Laboratory, P.O. Box 7166, University Station, Grand Forks, ND 58201.

Also participating in the study were researchers of the SEA Northern Regional Research Center, Peoria, Ill., and the SEA Spring and Durum Wheat Quality Laboratory, Fargo, N. Dak., as well as researchers and volunteers at the Human Nutrition Laboratory in Grand Forks.—*G.B.H.*

Big Pill Checks Bugs

A METHOPRENE bolus, or large pill, may eventually control the horn fly with one dosage per season.

A research team led by agricultural engineer John A. Miller, U.S. Livestock Insects Laboratory, has developed a sustained-release bolus that contains methoprene and controls the horn fly for 10 to 12 weeks with a single treatment.

An added benefit, says Dr. Roger O. Drummond, director of the laboratory, is that the long-lasting bolus treatment prevents development of cattle grubs. Drummond points out that the bolus does not prevent cattle grubs from appearing in the backs of cattle as does a standard systemic insecticide. The methoprene treatment allows the larvae to leave the backs of the cattle and become pupae. The treatment does, however, prevent the emergence of viable adults.

The bolus, which contains only 1 percent methoprene, is easily administered with a standard balling gun. The bolus is retained in the reticulum (second stomach) of cattle where it slowly erodes and releases methoprene over an extended period of time.

The bolus has advantages over mineral block and water treatments in that it does not depend on animal consumption, which can be highly variable. With the water treatment, cattle can frequently find untreated sources of water from streams and rainfall. If the mineral needs of the cattle are met by their natural diet, cattle will refrain from using the treated mineral blocks or they may use the blocks infrequently.

The scientists point out that control of the pests with the bolus treatment involves the use of less methoprene than the amounts approved by the Environmental Protection Agency for use in the mineral block treatment. Therefore, the bolus treatment should be safer and more economical.

The scientists are now working on other sustained-release bolus formulations to extend the period of effective treatment. Their tests strongly suggest that the methoprene bolus will be effective as a dual purpose control against both horn flies and cattle grubs.

Dr. Roger Drummond and Mr. John Miller are at the U.S. Livestock Insects Laboratory, P.O. Box 232, Kerrville, Tex. 78028.—*B.D.C.*

BOOTS for Cows

Above: Shoehorn, please: Dr. Horn helps a steer slip into one of his specially equipped boots (0578X592–14).

In Oklahoma even the cows wear custom-made boots. At least those working for SEA animal scientist Floyd Horn and electronics technician Gary Miller do.

Why is SEA providing cows with handmade leather boots complete with copper rivets and buckles? Because the boots, worn on all four feet of the animal, contain a sophisticated measuring device that can transmit, at any moment, the animal's weight with a margin of error within one pound in a thousand.

Transmitting from an FM radio in a backpack on the animal, the device in

*The very latest in bovine bootwear (**right:** 0578X595–12A), as demonstrated by Buford (**above:** 0578X595–15A), one of four steers scheduled for this unique weight watchers program.*

the boot is capable of providing a minicomputer with a continuous supply of data for processing. Or, the data can be recorded at random times, depending on research needs. The scientists simply call through the radio and ask that the data be transmitted back.

The researchers call the whole rig the Animal Weight Telemetry System. "This system—boot, radio, and computer—is a research tool capable of economically collecting, transmitting, and processing vast amounts of data. It enables scientists to study, at a distance, forage intake, small weight changes, and other aspects of the animal's metabolism," says Dr. Horn.

How do the cows take to the boots? Like most new shoes, they seem awkward and uncomfortable at first, but they break in nicely in a few hours.

After that, this intricate scientific system is just old shoe to the cattle.

Dr. Floyd Horn's address is Southwestern Livestock and Forage Research Station, Route 3, El Reno, OK 73036. Mr. Gary Miller is located at the Water Quality Laboratory, Route 2, Box 322A, Durant, OK 74701.—*B.D.C.*

Above: *Mr. Miller attaches the radio transmitter end of the Animal Weight Telemetry System to the back of a test steer (0578X593–9A).*

Left: *Back at the lab, Dr. Horn monitors the receiving end of the bovine boots broadcasting network. Weight measurements are accurate to within 1/10 of 1 percent (0578X594–23).*

Natural Pheromone May Trap Tsetse Fly

A NEWLY discovered pheromone of the disease-bearing tsetse fly may help to improve the trapping of these flies in the field.

Tsetse flies are the major vector of Rhodesian sleeping sickness in humans and of nagana in livestock. Animals with nagana literally waste away.

Chemist David A. Carlson at the Insects Affecting Man and Animals Research Laboratory reports, with two British colleagues, the first isolation, identification, and synthesis of sex recognition pheromones in the tsetse fly, *Glossina morsitans morsitans,* Westwood. The species is the most common, widespread, and hardy of the open savanna species.

The natural pheromone, a waxy secretion of the female fly which sexually excites the male, was extracted from the cuticle of females in the Tsetse Research Laboratory, University of Bristol, Bristol, England, by entomologist Peter A. Langley and research assistant Peter Huyton.

Three compounds, which independently bring on mating attempts by the male, were isolated from female flies. Males avidly grasped treated objects—pheromone-treated black shoelace knots—and showed strong stimulant activity responses, such as mounting and flexing of genitalia, when presented with the pseudofly.

The treated decoys were shown to be attractive only at ultra-short range and copulatory attempts began apparently only on contact with the pseudofly.

"We are now doing tests with the substances on small glass bead decoys so that we can find out what quantities are needed to induce the required male behavior. We also hope to establish what part of the male picks up the message of the pheromone," said Dr. Langley. "In the lab it seems clear that the male is not attracted by the pheromone from a distance. That is, he does not smell it, but reacts to it only when in direct contact with it. Our initial thought is that the appropriate sensors are on his legs."

Chemical studies of the pheromone were conducted at the Gainesville laboratory. "From chemical analysis we know the substances are 3 high molecular weight, branched-chain compounds, and very non-volatile," said Dr. Carlson. "Chemical and biological comparisons of the natural and synthesized compounds show that they are identical. The next step in the battle of the tsetse fly is to see how the synthetic material works in the fly's natural habitat."

The scientists expect the pheromone to work as an arrestant rather than an attractant. The flies attempt copulation with the objects treated with the pheromone and stay with them for some time, but are not apparently drawn from a distance. "The effectiveness of traps could be greatly enhanced by treating the traps or attached objects with the pheromone, together with a pesticide or chemical sterilant," said Dr. Carlson.

Effective trapping is essential before establishing a control program, and afterwards, as well, to find out if any flies have evaded control.

If the substance can aid in trapping the flies, it will be another useful weapon against the *trypanosomiasis* disease, which includes sleeping sickness. Livestock and domesticated animals are limited to areas in Africa free of the tsetse fly because of transmitted trypanosomes in animals, and the resulting disease, nagana.

Dr. Carlson and Dr. Langley hope to test the pheromone in Tanzania where a trial is underway to evaluate the sterile male technique with tsetse flies.

Dr. David Carlson is with the Insects Affecting Man and Animals Research Laboratory, PO. Box 14565, Gainesville, FL 32604.—*P.L.G.*

'New' Disease of Almond Trees

CALIFORNIA almond growers and researchers alike are "uneasy" about a relatively new disease of almond trees—almond leaf scorch (ALS) because of its potential threat to the state's more than 300,000 acres of almonds. California is the Nation's supplier of almonds.

ALS disease symptoms first appear on the almond leaf in early mid-summer. Initially, single branches show symptoms, and in succeeding years the entire tree may become infected. Yields of affected trees decline dramatically compared with the yield of healthy trees of the same age.

An area around Lancaster in Los Angeles County, once an important almond producing area, had 2,000 acres taken out of production as "golden death" or "almond decline"—common names for ALS—spread slowly through the orchards destroying productivity in 10 to 15 years. Four thousand acres of the super-susceptible long LXL almond variety in Contra Costa County near San Francisco are severely affected by the disease. The disease was first seen in the state in 1958.

ALS is widely distributed throughout California although its incidence is low with the exception of the two districts mentioned above. It has been observed in 10 different almond cultivars that collectively represent 86 percent of the total almond acreage in California.

Scientists are almost certain that the cause of the disease is a bacterium that can be spread by leafhoppers, spittlebugs or some other unknown vector and by propagation materials taken from infected areas to healthy almond producing areas.

Dr. Srecko M. Mircetich, SEA plant pathologist, Davis, Calif., was first to observe the bacterium in almond leaves through electron microscopic examination.

"Electron microscopic examination of ultrathin mid-vein sections of leaves from ALS infected trees revealed the presence of rod-shaped bacterial cells. The bacterium was not observed in any of the numerous leaf samples collected from healthy trees," Dr. Mircetich reports.

"A much similar bacterium had earlier been isolated from grapes causing Pierce's disease of grapevines, from peach trees causing phony peach disease, and from plums causing plum scale disease," Dr. Mircetich says.

Greenhouse studies, using leafhopper vectors, have shown that the bacterial agent of ALS disease can be moved from infected almonds to healthy almonds. Furthermore, the leaf scorch bacteria have also been transmitted from almond to grapevine, inducing symptoms of Pierce's disease. In a similar manner, the bacteria causing Pierce's disease in grapevine have been transmitted to almond to induce leaf scorch. That relationship is still under study.

Newly infected almond trees usually exhibit leaf symptoms in a single terminal branch and then in adjacent branches; within 2–5 years the entire tree may develop leaf symptoms. Scorched leaves first appear in affected trees about mid-June. The leaves at first show yellow areas either on the tip or on the sides that subsequenty dry out and die. The scorched areas gradually enlarge over the entire leaf. Severity and pattern of leaf scorch depend on the stage of disease, inherent character of the cultivar, and climate. The scorched leaves remain on the trees until fall defoliation. The affected trees become less productive; they then decline progressively, and often die within 3–8 years after the first appearance of leaf symptoms.

Diagnosis of ALS by visual observation of orchard trees is unreliable during the period from late fall to midsummer. Diagnosis is also complicated because symptoms of ALS may be confused with symptoms caused by excess salt and some herbicides. Scientists suggest that growers seek opinions of County Farm Advisors who should be able to help with diagnosing the disease.

Meantime, researchers are injecting antibiotics into trees to test for control. Control measures are limited to the selection of disease-tree propagating material and in cases where trees are infected in one branch or more, those branches can be severed about 3 feet below the leaves showing symptoms of disease.

California's almond crop during 1977 amounted to $267 million from 355,000 tons of in-shell almonds. Bearing orchards cover 259,000 acres. An additional 79,000 acres are in new plantings.

The recent findings of the bacterium causing ALS has spurred research efforts by the California Almond Control Board, the University of California, and SEA.

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UNITED STATES GOVERNMENT PRINTING OFFICE
PUBLIC DOCUMENTS DEPARTMENT, WASHINGTON, D.C. 20402

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AGR 101

AGRISEARCH NOTES

Lab-reared Flies More Potent

AFTER MORE than 240 generations, a laboratory colony of Mediterranean fruit flies at SEA's Hawaiian Fruit Flies Laboratory, Honolulu, is more sexually active than native flies.

Effects of long-term laboratory rearing on the physiology and behavior of laboratory-reared insects can directly influence the success or failure of programs such as the release of sterilized insects for suppression of native populations. As a general rule, laboratory-reared insects become weaker than natives.

In Honolulu, however, SEA entomologist Tim T. W. Wong and technician Larry M. Nakahara (now a Hawaii Department of Agriculture Entomologist) found that the medfly colony raised in the laboratory since 1956 has twice the mating ability before sterilization as the wild flies.

When the laboratory flies were sterilized by irradiation and marked with a dye for release in control programs, it was found that the steriles are sexually equal to the wild population.

The reduced mating ability brought on by the irradiation and dye indicates, however, that other functions such as flight activity or pheromone perception may be influenced by the treatment. "Therefore," says Mr. Wong, "it is uncertain whether the cage trials we conducted accurately reflect the ability of laboratory-reared medflies to compete with medflies in nature."

He says more tests should be made to study the behavior of released lab-reared and native flies in natural settings.

Mr. Tim Wong is with the Fruit Flies Laboratory, University of Hawaii, P.O. Box 2280, Honolulu, Hawaii 96804.—*J.P.D.*

Recent SEA Bulletins

Indoor Gardening

"INDOOR GARDENING" is a recent SEA publication providing information for the indoor gardener on topics such as artificial lighting, terariums, hanging baskets, and plant selection. Instructions in the care of plants, construction of various kinds of lighting fixtures, and directions on how to produce wall displays with hanging vines are contained along with instructive diagrams. "Indoor Gardening" is Home and Garden Bulletin number 220; single copies are available free from: USDA—GPA, Administration Building, Room 507–A, Washington, D.C. 20250.

Better Lawns

"BETTER LAWNS," SEA's Home and Garden Bulletin number 51, is a guide to establishing, maintaining, and renovating lawns. Specific problems such as Dollarspot, Leafspot, Snow Mold, and White Grubs are discussed, and information on lawn preparation, fertilization, and sodding is given. Many kinds of grasses are described—each description including advice on geographic suitability, insect vulnerability, and shade and/or sun requirements. Single copies of "Better Lawns" are available free from: USDA—GPA, Administration Building, Room 507–A, Washington, D.C. 20250.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

U.S. GOVERNMENT PRINTING OFFICE : 1978 O - 270-493